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CACTUS AND SUCCULENT JOURNAL

Of the Cactus And Succulent Society Of America

Vol. XX MAY, 1948 No. 5

FIG. 40. Dying specimen of *Pachycereus Pringlei* and a plant of *Machaerocereus gummosus* about three miles below the village of La Purisima and on the bank of Arroyo de La Purisima, Baja California.

CACTUS AND SUCCULENT JOURNAL

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FIG. 41. Fine stand of *Pachycereus Pringlei* with scattered shrubs of Creosote Bush and *Opuntia ciribe* (?) at the southern end of Bahia de la Concepcion, Baja California. The photograph on the cover of this issue of the JOURNAL and the one shown above illustrate the article by Dr. Ira L. Wiggins in last month's JOURNAL, "The Effects of Prolonged Drought on the Vegetation in Southern Baja California." Both photographs are by Dr. Harold M. Hill.

ARIZONA HIGHWAYS MAGAZINE—Christmas issue 1947. Contains 27 beautiful cactus and desert plants in color. The two cover pictures 9x12 inches are worth $5 as framed pictures of cacti. Postpaid 50c.

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EPIPHYLLUM HANDBOOK by Scott E. Haselton (1946). This first book on Epiphyllums and their hybrids gives their history and parentage as well as the flower parts and how to make descriptions. Complete cultural and propagation information. Explains hybridizing with pictures of all the plants used. Contains 250 pages with 170 photographs and 11 color plates. Price $3.50, postage U.S.A. 10c, foreign 50c.
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FIG. 42. MacDougall and Alejandro about to cross Tehuantepec River.

DOWN TEHUANTEPEC WAY

LADISLAUS CUTAK

Missouri Botanical Garden

Way back in my adolescent years I recall pictures of beautiful Tehuana girls walking regally through the streets of Tehuantepec, carrying gayly painted half-gourds on their heads filled with fruits, vegetables and other produce. Colorful costumes with good-looking individuals in them have always intrigued me. There is no denying that the women of Tehuantepec, as well as of Ixtepeci and Juchitan, possess the most picturesque if not charming costumes in all Mexico. Of course, the beauty of Tehuanas is very often exaggerated but many of them are exceptionally handsome in an exotic sort of way. Little did I dream that someday I would live among these natives and learn to like them for what they are.

The town of Tehuantepec was to be our headquarters during our stay in the Isthmus country. Tom MacDougall and I arrived in the city late one afternoon after a hard day's ride in a chartered 8-passenger bus out of Oaxaca. I must admit that for the first day or two it was hard to get accustomed to living in a hotel not up to my standards and to sit in the marketplace for my meals of unfamiliar dishes, but I got used to it to such an extent that I missed the place when we were in the back country living even more primitively.

Tehuantepec is a town of mostly one-story buildings divided into several barrios or neighborhoods, each with its own church and plaza. It lies along a bend of a river of the same name —a river that is broad but very shallow—where Tom and I were want to retire and bathe on hot days. Here the stream is never without occupants for it is a common sight to see groups of women and children splashing about, bathing and laundering their clothes simultaneously with unabashed candor. They have been doing this from time immemorial, yet now if the curious tourist stops momentarily to ogle the nude bathers will turn their backs to you or cover such exposed portions with their hands or wet clothes until you go on.

There are many interesting places in and around Tehuantepec. Our first trip was to the barrio of Lieza or rather its environs. From our hotel we hied ourselves to the river, following its course out of town. We had with us Alejandro, one of MacDougall's trusted guides. First, we stopped off at high cliff where a Hylocereus-like cactus hugged the rock walls high

above us. I had thought of taking a piece for study upon our return this way but unfortunately at the last moment our plans were changed and we did not come near it again. Alejandro mentioned that the flowers of this *Hylocereus* were eaten with relish by some of his friends.

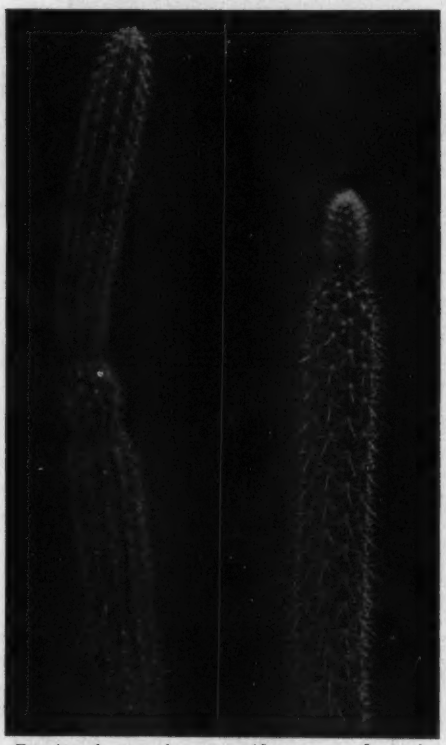

FIG. 43. Apparently a new *Nyctocereus,* from the Tehuantepec area, collected by the author.

Beyond one of the bends we took off our shoes and socks, rolled up our pants and prepared to cross the stream headed for the dry thorny thicket on the other side. Our course took us along a creek bed where exposed banks often displayed broken bits of pottery. After a heavy rain portions of the bank collapse and usually reveal interesting archeological artifacts. I picked up a small serpent head, apparently a handle from some bowl or vase. Cassia was blooming profusely everywhere. In small patches we noticed the oddly marked *Opuntia decumbens.* Its joints are of a lively green with deep colored markings below each areole. Occasional yellow blooms were prominently showing at the top of the pads. There was another prickly pear cactus with larger joints but its identity has not been ascertained. An Acanthocereus (possibly *A. occidentalis*) grew in abundance, its rather weak joints sprawling or aching over the ground, but my attention was drawn to a short, slender and colorful Nyctocereus which, as far as I know, is as yet not offered in the trade. In my estimation it should make a handsome pot plant. The fluted cylindric dark green joints are an inch in diameter and armed with variegated brownish spines. The spines on the young shoots are at first quite flexible and of a golden yellow color; some of them deep yellow, others pale straw and still others tinged an apricot orange from the tip halfway down. Later the spines become paler and variegated, the tip usually dull red brown, the base dull yellow brown and the middle chalk white. You can readily see how difficult it is to describe accurately the colorful spine armament. There are about 14 radial spines, 6 to 10 mm. long, and about 8 centrals, somewhat stouter with the lower ones often 11 to 14 mm. long. The spine count varies as I found out in examining several specimens in the field and there may be as high as 24 in an areole. This is a much higher spine count than attributed to any described Nyctocereus. On first thought I suspected it might be *N. oaxacensis* but on closer study it doesn't seem to agree with that species. Have we a new species here? Only further study will tell! Naturally, flowers are eagerly awaited to see what secret they may unfold.

Three types of torch cacti were in evidence but I did not make sufficient notes to compare them with described species. One appeared to be a Lemaireocereus with very long grey spines, another was a Cephalocereus of small stature with sparse wool and blackish spines while the third member was apparently a Pachycereus. The torch cacti of Oaxaca need closer study and I wouldn't be a bit surprised if some of the more prominent kinds are still undescribed. I have seen at least two which I am unable to place.

In the environs of Lieza district I saw for the first time one of the large leaf-producing cactus trees which are classified as the most primitive types in the family. The tree was *Pereskia Conzattii.* (See illustrations in Cactus Journal, June, 1940, p. 102 and August, 1947, p. 127.) The specimen was at least 20 feet high, leafless in February, of course, and the trunk at least 8 inches in diameter. The naked branches were supporting various bromeliaceous plants of the genus *Tillandsia,* producing striking blooms. I was thrilled to see this tree cactus, named after Prof. C. Conzatti, whom I had the pleasure of meeting in Oaxaca just a few days previous.

A pincushion cactus was quite prominent everywhere and often formed small clusters. At first I was inclined to associate it with *Mammillaria Karwinskiana* but as I began to study it

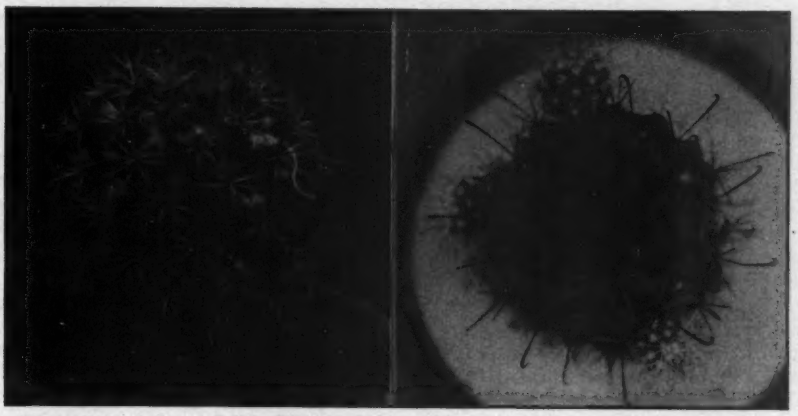

FIG. 44. *Mammillaria Collinsii* (left). FIG. 45. A *Mammillaria* that reproduces like an *Echinopsis;* close to *M. Beneckei* or perhaps a varietal form of it.

at the Garden I became convinced that it comes much closed to *M. Collinsii* than to the former and in the absence of flowers and seeds I am tentatively referring it to the latter. The individual bodies are 4.5 to 5.5 cm. wide. The tubercles are arranged in 10 and 16 spirals on our small plants. These are firm in texture, of a blue-green color, more or less pyramidal, with milky sap, 8 mm. long and at least 6 mm. wide at the base. Areoles are oval and bear whitish to tannish wool in the youngest, soon becoming naked. Axils are conspicuous with tufts of white wool and several (8 to 10) tortuous, white bristles which are quite frequently longer than the tubercles. A constant count of 8 radial spines seems to be the rule, although I detected 9 in one areole. These are acicular, straight, stiff, smooth, chalk white with red-brown tips, 5-7 mm. long. There is one central, which is porrect, just slightly stouter than the radials and practically identical in color although usually tinged a pink or pinkish brown and blackish at the tip, 5 to 8 mm. long.

A slipper spurge grew profusely in the short thorn thicket. There was nothing attractive about it, except the small slipper-shaped inflorescences crowning the tips of leafless green sticks. On first thought the ubiquitous Pan-American *Pedilanthus tithymaloides* came to my mind but a few cuttings were taken for further study, which later proved not to be that species but rather closely identical with *P. Pringlei* which is said to occur in Oaxaca. For obvious reasons, then, I am referring the Slipper Spurge of the Tehuantepec region to the latter entity. Pedilanthi are not very well known either in herbaria or in living collections; therefore, my interest in the genus is very intense. The most common met with in collections is the typical *P. tithymaloides* and its variegated varieties. Of the latter the graceful colorful stems are much sought for artistic arrangements. I sincerely believe that more interest should be taken in Slipper Spurges. Many gardens in southern California and the Gulf States would be enhanced by adding Pedilanthi to them. At our Garden we are cultivating more of these than perhaps anywhere else. In our desert house the plants make attractive specimens and are in leaf usually all year round.

Pedilanthus Pringlei of the Lieza district of Tehuantepec is a sparsely shrubby plant up to 3½ feet high. Its mature stems are about five-eights of an inch thick, of a dark gray-green and smooth. The young branches are dark green and sparsely puberulent. When leaves are present they are softly puberulent on both surfaces, oblanceolate, acuminate in the few observed, 1 to 2 inches long, subsessile, with margins more or less wavy and often tinged red. The midrib is prominently keeled beneath. The inflorescence or cymes are terminal, consisting of 3 or 4 involucres each subtended by small, red-tinged bracts less than 1 cm. long. The peduncles are dark green, glabrous, up to 8 mm. long. The colorful involucres are about 15 mm. long, deep pink to red above, green below, glabrous without and within. Main lobes are more or less extended ovate, finely ciliated on the free margins, the two lateral lobes linear, up to 9 mm. long and the median or fifth lobe slightly shorter. The appendix is 4-glandular, ligulate from a broadly ovate base, truncate at the apex, and microscopically ciliate-margined in the basal portion. The four glands are quite small, pale yellow and about one-half millimeter thick. In order that you will better understand the complex parts of the inflorescence I have prepared a sketch of this typical Pedilanthus for your benefit. The male flowers are

long exserted. Their pedicels and filaments are glabrous, the pedicels white and 17 mm. long; the filaments very pale green and about 5 mm. long; anthers pale purplish at first, later blackish-purple with pale yellow pollen. The pedicel and style of the female flower are likewise glabrous, the pedicel light green, 12 mm. long; the style dull brick red, about 9 mm. long, trifid at the apex, its lobes purplish and bifid. Ovary is dark green and about 1.5 mm. long.

A soft-leaved maguey, apparently of the alliance of *Agave rubescens,* was another conspicuous xerophyte in the short thorn thicket. It grew in dense clusters, the bluish-green leaves elongate-lanceolate, often purple tinged and rather thin. Innumerable bulbils were adhering to the withering inflorescences and at times dropping to the ground by their own weight where they continued to grow. Alejandro stated that the plant was known to the natives as "maguey mexicana." I brought back three of the bulbils which are now growing in our collection, hoping someday they will reach maturity and permit further study to reveal their true identity.

A plant of the pineapple family, *Bromelia Pinguin,* was quite common too. This species is to be found along the Pacific coast from Mexico to Panama. It is a coarse terrestrial which spreads by underground stolons and therefore forms large colonies when not hindered in its growth. The leaves are linear, acuminate, quite long, and armed with large curved spines along the margin. Better detour around the colonies if you wish to emerge unscathed for the sharp-pointed curved teeth can really tear clothing or lacerate flesh.

A visit in Tehuantepec would not be complete for a cactophile unless he would drop in on another cactus enthusiast and Tehuantepec has one bona-fide member of the Cactus and Succulent Society of America. In my August, 1947, SPINE CHATS I promised to tell you more about this man and his hobby and there is no better time to do this than now.

Wilbur Barker first saw the light of day in Covington, Kentucky, on October 15, 1883, and little did anyone present suspect that someday this cherub would forsake his homeland and seek fortune elsewhere, taking unto himself a

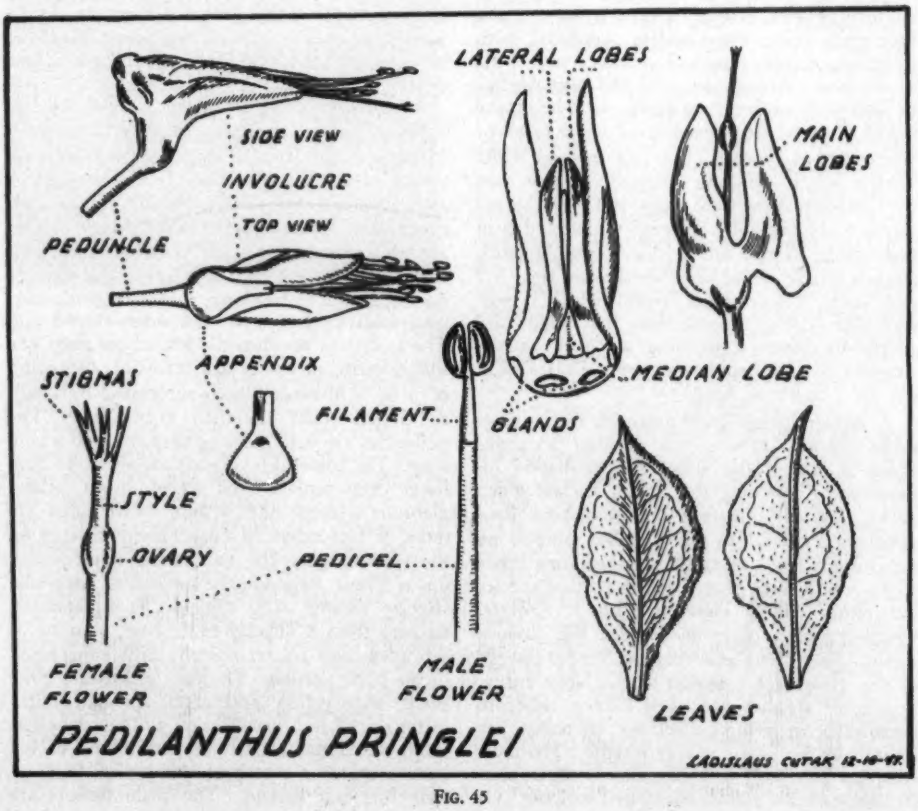

FIG. 45

native woman and living happily ever after. It all came about like this: Wilbur's father was manager of a large tobacco warehouse on the river front at Cincinnati but later he became associated with a coffee firm in Chicago and this firm owned a plantation at Teotitlan del Camino in the State of Oaxaca in Mexico. Wilbur had finished his grammar school in the Windy City and for the next few years did odd jobs to feel out his capacity in the business world but without success, as he confided to me.

One day, Mr. Barker induced the owners of the coffee house to send his young son down to Mexico as the manager of the plantation. The coffee finca broke up before Wilbur could assume his office but the president of the firm and a few other associates bought another plantation in the State of Vera Cruz and despatched 20-year old Barker to take charge. Well, he stayed at his post for four years and then switched to manage a rubber plantation near Cordoba. About this time romance had entered into his life. A beautiful Tehuana girl captured his heart and Mrs. Barker is still handsome despite the fact that she is a grandmother.

The Barkers moved to Tehuantepec after the revolution where they bought a small house on the other side of the river and Wilbur worked back and forth from one place to another, ran a small sawmill up the line a few miles and finally came to his present location and began to get interested in cacti.

The Barker home is enclosed by a high wall facing the street. As you enter the patio through a small door you will notice a Bougainvillea-draped shelter at the rear, living quarters on both sides and in the center of the yard is a date palm from which hang several pots planted with cacti and orchids. On the left is a balconied porch running the full length lined with potted plants of various kinds—local and exotic species of cacti, native orchids and ornamentals like Chamaedorea palms, poinsettias, etc. In one corner is suspended a hammock where Wilbur loves to retire and day-dream or to recall exciting experiences of other days. In another is a desk, table, benches and a radio to keep him informed of world news. Of evenings when there was little to do I used to visit Mr. Barker and listen to American music and news commentators to keep posted on the outside world; and then retire across the patio to the dining room where Mrs. Barker always had delicious food for us to be quaffed by cups of good tea. I never could get used to the black coffee served in the marketplace!

The Bougainvillea arbor is appropriately nicknamed "mammillaria dugout" by Barker. Here he has shelves built to hold his cacti, particularly the pincushions or Mammillarias, which he admires most. Among these was one species from the local hills which resembles *Mammillaria Beneckei* or perhaps an undescribed varietal form. The plant produces offsets on its body like an Echinopsis. The offsets show wool in the young areoles and white

FIG. 46. Wilbur Barker at the entrance to his Bougainvillea-draped "Mammillaria Dugout."

spines. The medium-sized plant in my possession shows tubercles in 7 and 11 spirals with watery sap and areoles with about 8 dirty white brown-tipped radial spines and usually 3 darker centrals, one of them hooked. If it proves identical with *M. Beneckei* it will be an extension of its range. Barker promised to watch the plants for flowers and seed and report to me so that I can ascertain whether the plant is the same as *M. Beneckei* or a new varietal entity of it. So you see 'down Tehuantepec way' there are many interesting things to see and riddles to be explained. Our journey was profitable indeed.

CACTI INDOORS

Most amateur collectors flounder around in the dark groping for advice and not knowing the best sources. Most of the literature and magazine articles are too scientific. Why not tell the hundreds of city dwellers how they may raise a few plants in their windows? Which kinds should they grow and can they expect flowers? How can we know which plants require full sun and which like some shade?

MRS. C. STEFENS.

ANSWER FROM ILLINOIS

I have successfully grown cacti and succulent plants for many years on window sills. Southwest exposure is very good and half day sunshine is enough. In my experience I found that too small pots are not practical as they dry out too fast; most amateur collectors are away from home during the day and are unable to water several times a day. Smaller plants can be grown together in one pot or box and even like to be somewhat crowded.

I prefer sandy soil mixture for all and during the growing season I water with manure water once a week (a handful of sheep manure in a gallon of water, stir and let settle, dilute with water until it looks like weak tea). As long as the soil is moist (I dig into the soil with a stick) no water is necessary but if I do water I make sure that the water gets to the roots—many plants rot when the surface is wet and the roots are dry.

So far, that looks rather simple but the biggest problem is still to be overcome—every collector likes his plants to bloom and most cacti will not bloom if kept growing continuously. To induce them to bloom it is necessary to give them a rest and here the difficulty starts. A collection in the living room is hard to put to sleep. If you have a garden, the plants should be out of doors during the summer and left there until late fall—even a light frost will not hurt them. Something should be done to protect them from the fall rains, in fact the soil should be rather dry. From here they go on a porch if available—sunshine is not important any longer as the plants are dormant. Here they may stay until freezing weather. From now on any cool room will do, even in the dark.

Towards the end of February I bring my plants back in the living room and at the same time do some necessary transplanting. The first watering should be done carefully but thoroughly on a sunny day. From then on, water sparingly until the plants show signs of life. Most cacti will show buds in a short time—first Mammillarias, Astrophytums, some Echinocactus, Echinopsis, Lobivias and Rebutias. Chamaecereus silvestrii (Peanut Cactus) will flower better when kept dry until buds show.

Many of the succulents will do all right if kept permanently in the livingroom if you can keep them from growing too rapidly (as cool as possible). Haworthias, Gasterias, Echeverias, and Stapelias will grow all winter and still bloom in the spring or summer. Some succulents are good winter bloomers as Kalanchoes, some Echeverias, *Urbinia agavoides, Euphorbia splendens* (Crown of Thorns), some Mesembs. and of course the Christmas Cactus. A porch that can be heated during the coldest months is ideal for permanent position of a collection; it is fine for the plants in the spring before they start to grow and you have no trouble in putting them to sleep in the fall.

HERMAN TOBUSCH.

BOOK NOTES

SUCCULENT PLANTS—Jacobsen

The revised edition of the most complete book on the other succulents is now available. There are over 300 illustrations with descriptions of 1000 species; mentions as many more in the 293 pages. English edition $6.50, postage 15c, foreign 50c.

TWO VOLUMES ON SEDUMS

These two little volumes were published in Sweden in 1936 but are available in this country now for the first time. There are 150 pages well printed with many photographs. Even though one cannot read their language, the pictures are an addition to any library. While they last $1.75 per set postpaid, foreign $2.00.

BIRDS OF THE ARIZONA DESERT—Smith, 1941. 38 birds are fully described and illustrated with superb drawings. A scientific description written in popular style is given for each species. A genuine masterpiece on the birds of Arizona and our southwestern deserts. Price $1.00 postpaid.

NEW EDITION OF THE STUDY OF CACTI

The revised edition of Mrs. Vera Higgins' *The Study of Cacti* is now ready for delivery. This is the best and only summary of the Britton and Rose classification. Understandable and especially recommended for beginners who wish to grasp the fundamentals in the study of cacti. The book contains 24 photos and a comprehensive chart for studying the differences in the various cactus forms. Postpaid in U.S.A. $3.00.

Dr. E. Werdermann, *Brazil and Its Columnar Cacti*—English translation of the German book. Bound in red cloth. An interesting tour of Brazil and the cacti found there $3.00. Postage: U. S. 7c, foreign 20c.

THE CACTUS JOURNAL OF GREAT BRITAIN

This valuable magazine was published quarterly with the first issue of Sept., 1932. The magazine was temporarily discontinued after the December issue in 1939. It will be impossible to ever obtain a complete set but we offer the 25 issues that are available (over six years' issues) $22.00 postpaid.

Backeberg's 1934 Catalogue, 40 pgs. with 72 excellent cactus pictures.....50c

Backeberg's *Cactaceae*, the distribution of cacti with 44 maps, 136 pages in German.....unbound $4.65, foreign $5.00

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FIG. 47. Haworthia plants—garden of G. G. Smith, East London.

A Splendid Garden of Living Haworthias

By HAROLD E. ANTHONY

At the conclusion of our field work in Nyasaland[1] Leonard J. Brass, the botanist of the expedition, and I had a few days in the Cape Province before we flew back to New York via Johannesburg. One of our most pleasant recollections of that sojourn was a visit to the home of Mr. G. G. Smith of East London. Mr. Smith is an ardent student of the Haworthias and an authority on the group. I have no doubt that he possesses the finest collection of living Haworthias in the world.

We visited his garden on October 24 and 25, spending several hours on each occasion. He lives on the outskirts of East London and his home is very attractive in every respect. The garden contains a great variety of succulents, mostly African but with a few cacti and other exotics. There are several small greenhouses and a few cold frames but the bulk of his plants are grown outside the year around. East London has a rainy season and a dry season and the latter can be very dry indeed. At the time of our visit the Cape Province was experiencing a bad drought. There had been so little rain that water was being rationed in the towns and cities.

Most of Mr. Smith's plants were doing very well and showed no adverse effects from the drought. The Haworthias, he told us, take wet and dry seasons outside and need no especial protection at any time of the year. As a group, the Stapeliads are the most vulnerable to the rainy season, although he has quite a variety of Ceropegias that thrive under the same treatment given to Haworthias.

A great many Haworthias are planted on the sides and tops of low rocky ridges, two to three feet above the paths that wind through the garden. These ridges are like rock gardens, affording good drainage and cool root runs under the rocks. The plants are grouped by species and varieties and there must be thousands of them. There are a great many lineal feet of these low ridges and they have various sun exposures. In some places the plants have sun for most of the day, in other spots the light is filtered through the foliage of trees and shrubs. Everything is orderly and well kept, the paths trim and the weeds removed.

Of almost equal interest to me, who must keep Haworthias in pots in New Jersey, was the great assortment of potted Haworthias on

[1]The Vernay Nyasaland Expedition, under the leadership of Arthur S. Vernay, spent about six months of 1946 in Africa.

FIG. 48. G. G. Smith's rock garden planted with Haworthias.

large tables set up under the open shade of several large trees. Mr. Smith has worked out a method for making cement pots of rectangular (square) cross-section and these pots seemed to be very practical. This was something I had thought of trying myself but never got around to it, so I was glad of this demonstration of the possibilities of cement. He has molds and his gardener makes a few pots whenever he has spare time, thus keeping a supply on hand.

In these hundreds, perhaps thousands, of square pots the Haworthias were thriving and happy. I presume that eventually the potted plant does not attain the optimum characteristics of the same species planted in the rock garden. But if the succulent fan can not own an all-year-around rock garden for Haworthias this collection in pots was an encouraging example of the next best technique.

Mr. Smith very generously gave us a great deal of living plant material to bring back with us, some of which we were able to include with our plane baggage. This has been growing very well in the New York Botanical Garden.

HOW CAN A SUCCULENT COLLECTION ATTAIN MAXIMUM USEFULNESS?

By G. D. ROWLEY

A person may like succulent plants, or he may not; it is impossible to be indifferent to them. By their very extremeness they compel admiration or abhorrence. But a liking for them can be acquired, and I am convinced that if only the confirmed "cactus haters" would take the trouble to learn more about the plants, their habits and strange ways of life, they would speedily develop an admiration for them as exceptional plants, if not a real love for them. The initial inconvenience of handling the spiny kinds, the prejudiced ideas that they never grow or flower (both quite false) or that they are poisonous (true only in one isolated case—Euphorbia)—these and other trifling notions, mostly quite ungrounded, can be swiftly dismissed, and so varied are the forms and modes of growth that it is hard to believe that there cannot be chosen some, at least, to suit the taste of everybody.

Here, briefly, are suggestions for gaining the maximum of enjoyment and interest from your collection:

1. Aim to keep the plants healthy and free from pests.

2. Record observations of flowers, time of flowering, mode of growth and propagation, response to various treatments, and so on in a diary or notebook. If the collection is large enough to warrant it, keep a catalogue or card index of species and genera.

3. Pay particular attention to accurate naming and labelling (never rely on memory!), and as far as possible keep all species of one genus or all genera of one family together.

4. Specialize on a particular family or genus, and study that as exhaustively as possible. Try to hunt out literature on the subject through libraries and booksellers—much of what has been written lies buried in periodicals and journals.

5. Try to contact others interested in the same subject—there are a surprising number about—and arrange exchanges of duplicates and hints.

THE MAMMILLARIA HANDBOOK—Dr. R. T. Craig. $7.50. Postage in U.S.A. 15c, foreign 50c.

Order now. Check your plants. This new monograph on Mammillarias contains 400 pages bound in heavy buckram and the same size as the smaller edition of the Britton and Rose Reprint. There are 236 species fully described and illustrated with 300 photographs.

Backeberg's *B. F. K.* (*Blatter fur Kakteenforschung*). This bulletin of cactus research was published between 1934 and 1938 and contains 460 pages and 250 photos. Each cactus is described in English. The most valuable material since Britton and Rose. Absolutely necessary for those studying classification. Unbound; spring binders available soon.....$6.75, foreign $7.25

BOX 101, PASADENA, CALIF.

EDITOR'S NOTE: We are reprinting the following article from the December, 1933, issue of the Cactus and Succulent Journal of Great Britain to show the high quality of the material contained in their fine magazine. Their Journal was interrupted by the war until July, 1946, when Mr. E. Shurly, as editor, published their Vol. 8, No. 3 quarterly issue. Even though the two English magazines have cost our American Cactus and Succulent Journal over 100 lost English subscribers, we are glad to assist such a worthwhile magazine. If you are not a subscriber you may send us 12 shillings ($2.50) and we will remit to Mr. Shurly.

Root Systems of Desert Plants

From the Cactus Journal of Great Britain

By VERA HIGGINS

Before considering the special adaptations of the roots systems of desert plants necessitated by their unusual environment, it may be as well to review briefly the normal structure and action of roots. The root is the organ by means of which a plant is able to take in salts in solution from the soil in which it grows. Roots vary in length enormously but the only part that is capable of absorbing liquid at any given times is near the tip; the greater part is covered with a corky layer through which water does not penetrate, and the internal structure is such that the liquid absorbed by the tip can be rapidly carried to the plant body.

The tip of a root is the growing region; it consists of very delicate cells which are constantly dividing; to protect the tip as it pushes its way through the earth is a structure known as the root cap; this consists of a mass of cells covered with a corky layer which is gradually worn away as the root burrows; fresh layers are added to the root cap by the growing point of the root itself. Just behind the root cap the outer layers of the root proper are thin walled and the cells of the outer layer form hairs; these root hairs are the most important part of the root, as they alone take up water and the food substances contained in it. These root hairs are very noticeable in seedlings but are always present on active roots; each hair lasts for a day or two only and is replaced by others as the root pushes forward. The degree to which root hairs are developed depends on the difficulty of obtaining water; in a dry soil root hairs are produced more freely than in a wet one.

Roots take various forms which are directly related to the plants they support. Thus plants with tap roots have their leaves so arranged that any water falling on them is conducted towards the centre of the plant. Plants with spreading leaves and branches have fibrous roots spread out to catch water over a wider area; in forest trees the roots will be found to spread under the ground to the same distance as the branches spread above so that the water drips off the branches. on to the soil where the tips of the roots can make most use of it.

The absorption of water by a plant cell is only possible if the cell wall is very thin; as soon as the wall is thickened by the addition of extra layers or rendered corky by a chemical change, the cell becomes incapable of taking in liquids. The process by which solutions are absorbed is known as osmosis and depends on the principle that salt solutions tend to become equal in strength when separated only by a semipermeable membrane. Hence, if the sap in a cell consists of a stronger solution than that which surrounds the cell, water will tend to pass through the cell wall until a balance is obtained. In actual fact the process never reaches a state of balance since the cell in contact with the exterior solution touches on its other sides cells similar to itself, where the interchange of solutions goes on till the water acquired from outside reaches the conducting system of the root and so passes up into the stem and leaves.

Only weak solutions will pass through the cell wall and from these must be obtained all the substances, with the exception of carbon, that are required for growth; it follows that a very large quantity of water must be taken in by the root system to provide enough material; the surplus is given off by the leaves in the form of water vapour.

Soils vary very much in composition but the substances necessary for plant growth are usually present, though in varying amounts. The size of the particles is more important than the chemical composition, for on this depends the amount of water that a plant can extract from the soil. In clay, where the particles are very fine, only a small amount of water present can be absorbed by the roots, whereas in a sandy soil, where the particles are larger, almost all the water present can be utilised. The reason for this is that the water between the particles is not available, but there is a film of water which is held by capilarity closely round each particle and this is the form in which the roots can take up water most readily. When the root hairs withdraw this film of water from a particle, the film is replaced by water from an adjoining particle and so on, thus the plant can collect water from a considerably greater area than the roots actually cover. Surplus water between the soil particles is useless to the plant; such a soil is water-logged. For healthy growth the presence of oxygen is necessary; it is probably not absorbed by the roots to any great extent, though a little will pass through the lenticels or breathing pores in the corky covering of old roots. But if air (which of course contains oxygen) is not present in the soil, many necessary chemical processes are hindered, useful bacilli cannot live and the soil develops acids and becomes "sour." The presence of air in the soil is quite as important as the presence of water. Experiments have shown that if oxygen is entirely removed from the soil, root growth ceases entirely in all species of plants; some species grow very slowly if 0.5 per cent. oxygen is admitted, but a much greater supply is required for normal growth by the majority of plants. Such plants as Juncus, the rush, which occur in boggy ground are able to maintain a slow rate of growth where the oxygen supply is very low, but Fouquieria, Opuntia, Mesembryanthemum and other plants which normally grow in loose, sandy, well-aerated soil are very intolerant of a shortage of oxygen.

The extreme conditions that exist in desert regions have necessitated considerable modifications in the structure of such plants as are able to live there; these modifications are due to two main causes—the shortage of the water supply and the high temperature. The latter chiefly affects the plant body; where plants have shallow roots these will be at a temperature approximating to that of the plant itself, but the temperature decreases at lower levels so that a deeply-rooted plant may have a considerable temperature gradient between its lowest roots and the shoot. For all plants there is a minimum temperature below which growth ceases, an optimum at which it is carried on most freely, and a maximum above which growth is again inhibited. These three temperatures vary not only for a different species of plant, but also for the root and shoot of the same plant, being generally lower for the root than for the shoot.

The second factor that materially modifies desert plants is the water supply. Not only is there a great scarcity of available water in the soil but the air is so dry that evaporation is enormously increased. In

some deserts the annual rainfall may be as much as fifteen inches, which in a temperate region might be sufficient to support a normal vegetation, but the extreme dryness of the air and the high temperature makes this amount quite inadequate.

The adaptations of the plant body to meet desert conditions are familiar to all growers of cacti and other succulent plants; the thickened cuticle, reduction of leaf surface and storing of water are the chief means of protection. But the roots of desert plants must also play their part. In a moist soil the root system will be only moderately developed; in a bog the roots branch, but root hairs are not developed to any great extent; the lack of air is the chief difficulty for bog plants, resulting, in extreme cases, in the development of pneumatophores—roots which grow up out of the soil into the air, as in the Mangrove. The soil in most desert regions is usually sandy and open and the oxygen supply presents no difficulty; but to obtain sufficient moisture the root system must be extensive, much branched and with a free development of root hairs.

It has been mentioned that water is absorbed through the cell wall by the process known as osmosis; the ability of a plant to take in solutions is measured by the osmotic pressure and is dependent on the concentration of the cell sap; if this is high the osmotic pressure is said to be high and the plant is therefore able to extract more water from the soil than one with a low osmotic pressure. It is typical of non-succulent xerophytes (plants adapted to a shortage of water) that the osmotic pressure is abnormally high; this, coupled with an extensive root system, enables the plant to obtain sufficient water for its needs. Investigations have shown that typical desert plants, such as the Mesquite bushes of America and the Acacia scrub of the African deserts have wide-spread, much branched root systems.

A common fallacy is that desert plants must have extremely deep roots, so that they can reach the water table, the level at which standing water will always be found. This may be the case with such plants as grow in soils, arid during a portion of the year only, but which become swamps or stream beds during the rainy season. A plant of *Prosopis juliflora* near the Amargosa River in California is reported to have had a main root running downwards for fifty feet. But as a rule the water table is several hundred feet below the surface of the desert and quite inaccessible; besides, after the slight moisture of the upper layers due to showers, the soil becomes increasingly drier for some distance so that there is no incentive for the roots to push further in that direction.

When we consider succulent plants we find that different conditions occur. Instead of the high osmotic pressure of typical xerophytes, the osmotic pressure of succulent plants is abnormally low, lower even than that of plants growing in normal situations. It is interesting to note that even lower osmotic pressures are found in epiphytes, plants which grow on trees and shrubs so as to be nearer the sunlight, but have no organic connection with their hosts; such plants depend for their water supply on intermittent showers and must make provision for the dry periods intervening. Epiphytic orchids are typical examples; these store water either in stems or leaves or in special forms of stem known as pseudo-bulbs. This similarity between succulent plants such as the cacti found in the desert and true epiphytes is interesting, for the cacti which grow in tropical forests are often epiphytes and it is generally considered that the desert types have been evolved from these.

It is sometimes thought that cacti do not have many roots; in fact an article appeared in one of the daily papers where it was stated that cacti flourish in arid regions "despite the scantiness of root, which is one of their chief characteristics"! This misconception probably arises from the fact that cacti are able to exist for long periods on the reserves stored in them; a case is recorded of a cactus which was kept for two years in a museum case in dry air at a constant temperature, yet on being placed in congenial surroundings, the plant was able to put out roots and start into growth once more.

Every amateur grower has had specimens that have sat for months, neither dying nor growing, but just existing; yet when a favorable moment comes they will put forth roots and begin growing again. The fact that we are not always successful in inducing root growth in cultivation does not mean that in their natural habitat cacti do not make large root systems. Investigations carried out by Dr. W. A. Cannon at the Desert Laboratory at Tucson yielded interesting results. The root system of an *Echinocactus Wislizenii* was carefully uncovered and its ramifications traced out. The plant itself was about 25 inches high and 14 inches in diameter; three main roots sprang from the base of the plant at about 4 inches from the surface of the ground; these spread out fairly evenly in all directions and branched very considerably, the branches being, as a rule, slender. The average depth of the roots below the surface was 2½ inches; where a stone was encountered the roots dipped below, probably attracted downwards by the greater moisture on its lower and cooler surface, but they rose again on the other side. The greatest distance to which the roots could be traced was over 10 feet from the base of the plant.

The roots of a small *Cereus giganteus** were also traced out. The plant was about 3 feet high and had four main roots. One of these struck vertically downwards and could not be measured; a plant growing to the height that this *Cereus* normally attains, might be expected to have deep roots to counter-balance the height. The other roots ran horizontally about 3 to 4 inches below the surface, but could not be traced at a greater distance from the plant than 3 feet, as they were then extremely thin and fragile.

The fact that the root system of a single plant spreads over so wide an area results in the characteristic feature of deserts, namely, the distance between the individual specimens; arid districts are always sparsely covered with vegetation, and though a species may be represented over an area of many acres, the separate plants may quite likely be a yard or more from each other. The ground between them may be either bare or inhabited by a different species drawing water from a different level.

The root system of a *Cereus giganteus* in relation to other species growing near it was investigated by Dr. Cannon. The cactus had growing near it *Larrea tridentata* (the Creosote Bush) and *Parkinsonia microphylla*. The *Cereus* was a vigorous plant about 4 feet high; the root system consisted of a tap root and strong laterals; the soil consisted of a layer of adobe clay with boulders in it, about a foot thick, below which was an 8-inch layer of caliche; this is a calcareous formation which ocurs in many parts of the desert, occasionally on the surface but generally covered with a layer of earth; it is almost impervious to water but it is generally traversed by small holes through which roots find their way. The caliche in the instance under consideration was lying on solid rock. The main root of the *Cereus* penetrated the upper layer but stopped at the caliche; the lateral

Carnegiea gigantea, the Giant Cactus of Arizona.

roots were extended for as much as 17 feet, but were in the upper layer only, and usually within 4 inches of the surface.

The *Parkinsonia* growing along side had rather deeper lateral roots, which ran obliquely through the upper layer, penetrated the caliche and finally travelled along the surface of the bed rock. The creosote bush had side roots running chiefly in the upper adobe layer but deeper than those of the *Cereus*, being usually over 6 inches from the surface: later they also penetrated the caliche and finally reached the rock. As far as the root systems of these plants were traced out there was only one point found at which the roots actually touched each other; the soil was being most thoroughly exploited, but the plants did not interfere with each other in any way. The root system of this *Cereus* showed another feature characteristic of some cacti; it has been noted in certain Opuntias also. The main branches give rise to a tuft of rootlets which persist for a time only and then die off; sometimes the root will die back even further and the next season a fresh crop of rootlets is developed. In this way the plant is able to re-work the ground, as it were.

The very shallow arrangement of the roots in many cacti is largely the result of the small rainfall, but it is probable that it is also due to the fact that these upper layers are better aerated; full investigations have not been carried out on the need for aeration of cactus roots, but since the respiration of the plant itself is considerably reduced below normal, the aeration of the roots is doubly important.

We have so far only considered those plants which have a system of fibrous roots, but the storage of water may be undertaken by the root as by the stem. Thus the branches of *Peniocereus Greggii* are moderately succulent, but the tap root develops to an enormous size like a parsnip, and examples have been found weighing as much as 100 lbs. The genus *Wilcoxia* has tuberous roots rather like a Dahlia, supporting the slender leafless stems. In several cacti such as *Ariocarpus* and *Lophophora* the base of the plant merges into a thickened root stock and this occurs in other species also. But an unusual form is found in at least two Echinocacti—*Thelocactus mandragora* and *Thelocactus subterraneus;* here the tap root is much enlarged and bears above it a short woody stem which in turn carries the succulent plant body; the intervening portion of woody stem is unusual.

It is only natural that the stem and leaves should have attracted more attention than root systems; their unusual form having made them especially interesting objects of study. The roots, on the other hand, have as a rule only been noted when they assume an extreme form. Experimental work has already been carried out on roots, but much remains to be done if the physiological condition of the plant is to be fully understood. For though the interest and beauty of a plant is centered in the stem, leaves and flowers, these organs cannot reach their full development without proper root action.

And from this we may draw a moral for our methods of cultivation; if we want the shoot to grow to the best advantage we must make sure that the roots are suitably provided for. One of the chief dangers in growing plants in pots—and though this applies more especially to cacti and other succulent plants, it should also be taken into consideration for all pot plants—is overwatering. If the water poured into a pot can drain right through and be carried away, there is little danger; the soil particles will take up what they can and when each has its film of water, the plant can get what it wants; but if the pot stands on the staging so that water is held in the soil, then the danger that the valuable air spaces between the particles will be choked is always present and a very good chance that the soil will become "sour," and the roots unable to do their work in the absence of the necessary oxygen.

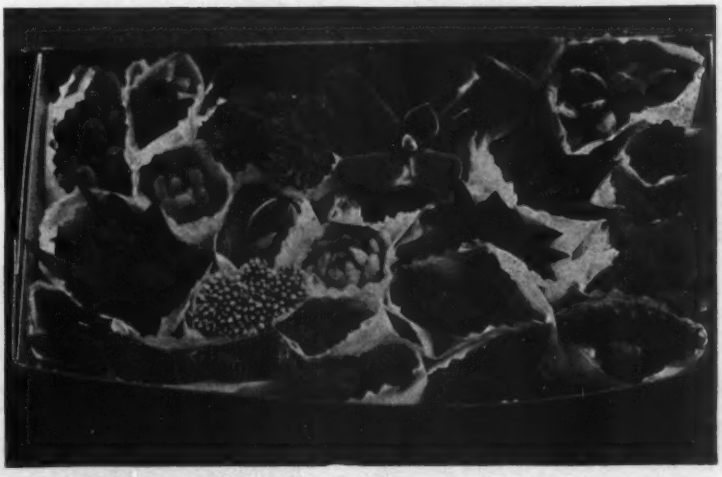

FIG. 49.

A BEGINNER'S COLLECTION

Krejci Gardens, 10002 Sharp Ave., Pacoima, California, are packing 40 succulents consisting of Echeverias, Stapelias, Crassulas, Gasterias, Haworthias, and Sedums for bowl plantings (Sample box $1.25 postpaid). A box of these colorful and interesting plants is a treat to even experienced growers. Collectors often result from a beginners box of this kind.

FIG. 50. The Beahm Gardens, Pasadena, California, is the first to picture a cross between a Selenicereus and an Epiphyllum hybrid. The seed parent, *S. spinulosus*, was crossed with the Epiphyllum hybrid, Tulip. The resulting plant retains the form of its seed parent and flower color is straw-orange with a large lavender eye. This shows that it is possible to introduce colored flowers in Selenicereus. Photo by Sherman E. Beahm.

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The student of succulent plants continuously finds a great lack in the availability of continuous and comprehensive literature on any particular group of plants that he might be attempting to work with. Botany has, as a science, failed to produce much monographic material on the succulent plants, perhaps, principally, because of a lack of philanthropic capital applied to the production of such material. Due to the materialistic standards of success and creation being mainly measured in the amount of dollars thereby derived we have had only a limited number of standard works published.

Our greatest source of material has been through the medium of those magazines devoted principally to the succulent plants, and, perhaps the most valuable reference material that one who is interested in these plants could have is "The Cactus and Succulent Journal." I do not believe, that as its editor, there is any one man in this country who has contributed more to our cause than Scott E. Haselton. In my searching for material regarding succulent plants throughout my 15 years of collecting I have most consistently found the greatest amount of worthwhile information in one or the other issues of this JOURNAL.

Through the medium of the JOURNAL, much valuable information has been disseminated and a greater following of more seriously interested people has been the result. Were it not for this publication, many plants which most of us have in our gardens today would not be there. This magazine is a common meeting ground where we form a common bond and contribute to an otherwise much neglected branch of the biological sciences.

I believe that a person who has any interest in cactus and succulent plants should *consistently* maintain his *personal* membership in the Cactus and Succulent Society of America, thereby receiving the JOURNAL of this Society, while he is helping to keep in continuous existence one of the most worthwhile sources of information. Clubs which have only the *club's* subscription are doing themselves a great injustice in weakening the necessary support of a structure that contributes such valued information for their benefit. To be of the greatest benefit, *each* person should maintain his own library of such reference material, especially when it *is* so easily acquired.

We must also remember that the JOURNAL was the only scientific magazine that was published without interruption during the war. It was this magazine that kept alive the interest in succulent plants. Now, with the many new and old magazines entering the field, do not forget to support the magazine that stood by you during those trying years. Continuing your membership in the Cactus and Succulent Society, with its JOURNAL, is the loyal way to show your appreciation.

MACE TAYLOR, Carlsbad.

FIG. 51. *Ariocarpus Kotschoubeyanus* (see next pg).

SPINE CHATS

LADISLAUS CUTAK

There are a number of botanical curios in the Cactaceae worthy of collecting. Among these curiosities, the "Living Rocks" are much sought after. They require very little care and take up hardly any room on our windowsills. One of these mimic cacti is said to have paid in gold its passage to Europe over a century ago and because it is one of the most diminutive in the group I shall consider it as my plant of the month. The name by which it is known in botanical circles is *Ariocarpus Kotschoubeyanus*, honoring the princeling who gave a thousand francs for its possession. Today this plant can be bought for fifteen cents! The diminutive cactus is native to Mexico only. On one of my collecting trips, my party had gone to the desert near La Rosa, about 30 miles west of Saltillo in Coahuila, and although we searched on hands and knees it was fully an hour before we located our first one. The plants, less than an inch in diameter, possess flattened crowns which were level with the ground in which they grew and because they were covered with the dry ground washed over by past rains it made our search for them doubly difficult. However, after locating the first one our eyes became acustomed in spotting others.

Ariocarpus Kotschoubeyanus was first collected in 1840 but not described until two years later. It is best to grow the plant quite dry and in a container which is deeper than broad, filled with regular cactus soil mixture impregnated with lime. For better growth and fool-proof security against rot it is advisable to graft the species to a Lemaireocereus stock of equal diameter. The plant is composed of a flatened crown and a subterranean rootstock. The former consists of dull grayish green tubercles with wool in their grooves while the latter is a succulent taproot with several spindle-shaped roots. The whole plant is only two to three inches long. Flowers originate in the center at the top and measure 2 cm. long by 3.5 cm. broad when fully opened. The sepals or outer perianth segments are few, about 7 in number, brownish green on the outside, purplish with whitish margins on the inside, apiculate. The petals or inner perianth segments are oblanceolate, apiculate, deep purplish and widely spreading. The filaments are white with deep yellow anthers while the style is light purplish and slightly longer with six light purplish to white-margined stigma lobes crowning the apex. *Ariocarpus Kotschoubeyanus* is a late fall bloomer with flowers coming as late as November.

* * *

M. P. De Vos undertook a cytological investigation of the Mesembryanthemeae to determine the chromosome morphology of the genera and species in this large sub-family of the Aizoaceae and to ascertain whether these results would help in elucidating taxonomic problems in the group. The chromosome morphology of 89 species belonging to 33 genera has been investigated. The investigation showed that the fundamental chromosome number for the Mesembryanthemeae is 9 and that polyploidy occurs within many genera. The frequent occurrence of polyploids in the sub-family points to the fact that evolution of new species is occurring through polyploidy in this group, either through a duplication of chromosomes in hybrids or through intraspecific chromosome races. Those who might be further interested in these studies are referred to the Annals of the University of Stellenbach (vol. 25, Sect. A, No. 1, 1947).

* * *

The state of Texas is setting an example in highway beautification that is not at all approached in any other state, and has been doing it for many years. This information comes from the January, 1948, Wild Flower, official publication of the Wild Flower Preservation Society. The state is divided into highway districts with a Landscape Adviser attached to each district. These advisers have a high regard for conservation of native plants and for beautifying the highways, particularly those highways with somewhat scanty natural vegetation. The mesa area in the western part of the state is brightened by the planting of stately specimens of *Yucca Treculeana,* one specimen at each end and on opposite sides of all bridges and culverts. These specimens average 10 to 15 feet tall when in bloom. In other areas other species of Yucca are often planted, but none make such a show as *Yucca Treculeana.*

* * *

The third national cactus convention is fourteen months away and although it seems like an awful long time it will be upon us before you realize it. Are you making preparations to attend? My wish is to see and greet each and every one of you at the 1949 gathering in Arizona. If our plans go through, you are in for a grand time. Chairman Howard Gates, myself and our Committee are trying to arrange a picnic trip to the Boyce Thompson Southwested Arboretum, one of the outstanding attractions in the Saguaro State. The Arboretum is located about 60 miles southeast of Phoenix in a very picturesque desert valley above which towers historic Picket Post Mountain. Here we will be able to see a wonderful assemblage of cacti as well as sub-arid ornamentals from all parts of the world. Here we will also get a chance to meet Mr. Fred Gibson, present director, who has served in this capacity since 1934. Fred is an old friend of mine and I want to introduce the gentleman to you beforehand. How vividly I recall our first meeting in 1935 when he offered the use of the guesthouse during my visit! Fred sauntered over that first evening to see that everything was made comfortable for me and we talked long into the night until the first signs of a coming electrcial storm drove him home. I found out that he was born on a grain farm near Tipton, California, in 1892, but spent his boyhood at Clovis, near Fresno, where his father operated a general merchandise store from 1898 to 1917. He entered University of California in 1913 and took up electrical engineering, then joined the Army during World War I and went back to college in 1919 where he graduated in horticulture at the University of Arizona. He joined the faculty as assistant plant pathologist in 1921 and relinquished his job in 1924 to become assistant director of the Arboretum. Training in engineering, agriculture and botany fitted him well for this job.

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